and such winds did not, as a rule, correspond at all with the "kite winds." Wind data taken on shore and near the earth—say within 100 feet or so—are utterly at variance with those obtained in the "free air" above the surface of the sea. Hence, empirical formulas based upon surface data are worthless.

The velocity of the wind as indicated on the summit of Diamond Head was from two to three times as great as that indicated at the United States Weather Bureau station in Honolulu.

Ballisticians have arbitrarily assumed that the drift of the projectile is independent of wind conditions, whereas a little a priori reasoning would have shown the fallacy of this assumption. But, be this as it may, our firings proved conclusively that the drift did vary with changes in wind conditions.

All who have followed this discussion will undoubtedly agree that the coast artilleryman attempting to hit a moving target at sea has a pretty problem to solve, considering that his accuracy of fire depends upon unknown aerological conditions, unknown variations in drift, and unknown changes in the muzzle velocity of the powder employed.

551.5 (73)

WEATHER BUREAU EXHIBIT AT THE FIRST PAN AMERICAN AERONAUTIC EXPOSITION.

By WILLIS RAY GREGG, Meteorologist.

[Aerological Investigations, Weather Bureau, Mar. 14, 1917.]

The First Pan American Aeronautic Exposition was held in the Grand Central Palace, New York City, February 8 to 15, 1917. The purpose of this exposition was to stimulate general interest in aeronautics by means of exhibits and to promote the more rapid advancement of this science by means of addresses and discussions. The latter were given each day in the Convention Hall and were illustrated by lantern slides and motion pictures. Of considerable interest among these was the Weather Bureau's motion-picture illustration of meteorological kite flying at the Drexel Aerological Station.

The exhibits occupied the two lower floors of the palace. Those on the first floor consisted, for the most part, of different types of aeroplanes, an interesting feature being the first motor-driven machine, in which the Wright brothers made a successful flight at Kitty Hawk, N. C., in 1903. In the open court above the first floor were suspended a large military kite balloon and a model of a manned free balloon. These and some other details of the first-floor exhibit are shown in figures 1 and 4.

On the second, or mezzanine, floor were shown models of aeroplanes and dirigibles, various types of motors and some of the later designs of propellers. There were also exhibits, consisting principally of pamphlets for distribution, by the Pan American Union, the National Security League, and the National Advisory Committee for Aeronautics. A part of this floor was devoted to exhibits by some of the Government departments, including the Bureau of Standards, Coast and Geodetic Survey, Army and Navy, Postal Service, and the Weather Bureau.

The Weather Bureau exhibit consisted of most of the instrumental equipment usually shown at expositions and, in addition, some of the instruments, apparatus, etc., used by the Aerological Division. The usual exhibit has already been described in previous numbers of the MONTHLY WEATHER REVIEW. (Vol. 43, p. 452, and vol. 44, p. 459.) Besides these instruments there was also shown a Robinson anemometer so modified that electric contact is made for each one-sixtieth of a mile of wind blown, thus enabling the observer to determine the current hourly velocity by merely counting the number of contacts made in one minute (see this REVIEW, 44:288). An electric fan operated this anemometer; also one connected in the usual way with the triple register. The latter and a barograph and thermograph were kept continuously recording. Much interest was shown in these instruments and in the glass weather map, which showed the weather conditions and the forecast for each day. The general arrangement and appearance of this part of the Weather Bureau exhibit are shown in figure 2. A large number of descriptive pamphlets on "The Weather Bureau" and "Explanation of the Weather Map"; also cards explaining the flags used for warnings were distributed during the exposition.

The aerological exhibit included a kite, kite reel, recording theodolite, 2 kite meteorographs, 1 balloon meteorograph, piece of sounding balloon rubber, a number of free air records obtained by means of kites, captive and sounding balloons, and copies of the Mount Weather Bulletin and Monthly Weather Review containing summaries of free air work. Figure 3 shows the kite, with meteorograph attached, kite reel and some of the instruments; in figures 5 and 6 the instruments can be seen in somewhat greater detail. All of this apparatus has been in regular use by the Weather Bureau, except the recording theodolite which is of recent design and construction. Its use in pilot or sounding balloon work will require but one observer, whereas, with the nonrecording theodolite, it has been necessary to have two observers; one to keep the balloon on the cross hairs, the other to record the angular readings. Much interest was shown in these instruments and in the piece of sounding balloon rubber, it being pointed out that all of our pure rubber balloons have been obtained from Europe and that no satisfactory samples have yet been produced in this country.

Greatest interest was apparent in the meteorograph records, which were briefly described on attached cards, and in the summaries of free-air data. It was evident that comparatively few of those actively engaged in aviation are aware of the existence of tables and charts showing temperature and wind conditions at various levels and under different conditions of pressure distribution at the earth's surface. The direct bearing and value of this work to aviators was emphasized, with the result that there were numerous requests for the summaries already published and for all publications along this line that may be issued in the future.

551.596 (41)

SOUND AREAS OF THE EXPLOSION AT EAST LONDON, JANUARY 19, 1917.[1]

By CHARLES DAVISON.

It is not often that a great explosion occurs near the center of a populous area, and the recent disaster in East London, England, thus offers an opportunity of adding to our knowledge on the transmission of sound waves by the atmosphere. * * * The most remarkable result [of recent investigations in this subject] is the recognition of the fact that there exists sometimes, not always, a zone of silence which separates two detached sound areas. This zone has been traced in 20 recent explosions (excluding that of Friday, January 19), two

[1] *Condensed from* Nature, London, Feb. 1, 1917, 98: 438–439, by W. G. Reed.

being due to gun-firing, four to explosions of dynamite or gunpowder, and the remainder to volcanic explosions in Japan.[2]

The source of sound is always unsymmetrically placed within the inner sound area, and nearly always lies on the side facing the outer sound area. On this side the boundary of the inner area may be as near as 2½ miles, or as distant as 39 miles, from the source. The most important dimension, however, is the radius or mean radius of the curve that forms the outer boundary of the zone of silence. It is far from being constant. It may be as low as 50 miles, as in the case of the minute-guns fired at Spithead on February 1, 1901, or as high as 99 miles, as with the Wiener-Neustadt explosion of 1912. * * *

Though later accounts may modify some of the dimensions given below, a first analysis of the reports already received shows that the explosion at East London on January 19, 1917, belongs to the class with double sound areas. *The inner sound area* is of unusual form, being L-shaped with the angle near Godalming, the east-west limb reaching to Canterbury, and the north-south limb reaching to the neighborhood of Northampton. The least distance of the boundary of the inner area from the source of sound is about 12 miles, and the greatest distance is 65 miles.

The outer sound area lies to the north of the other, with its center a few miles west of King's Lynn. Its longer axis, 131 miles in length, reaches from the neighborhood of Nottingham to that of Lowestoft and is about 55 miles in width. *The zone of silence* varies in width from 16 miles (near Northampton) to 54 miles, and the distance of its outer boundary from the source is about 60 miles. So far as is known at present it includes the greater part of Essex and Suffolk, the southern half of the counties of Cambridge and Huntingdon, and the central portion of Northamptonshire. Even if observations should be received afterwards from this area, it is significant that from the inner sound area of about 3,500 square miles there have so far been received 250 records in which the time is given, from the outer sound area of about 5,700 square miles 223 records (including 122 from Norfolk and 56 from Lincolnshire), and from the zone of silence of about 4,500 square miles only one record and that one close to the sea. The greatest distance to which the sound waves penetrated is about 121 miles.

A remarkable feature about these records is that, although all have been sent in reply to my newspaper letters (and therefore sent as it were at random), they are almost as thickly grouped near the boundaries as near the centers of the two areas. There is none of that increasing sparseness of records near the boundary which is so characteristic of earthquake investigations. It would seem as if the boundary were determined, not by the sound vibrations becoming inaudible, but by the absence of sound vibrations from the area beyond. It may be of interest to add that, at a large number of places, pheasants showed signs of alarm as they did during the North Sea battle of January 24, 1915. * * *

[2] *Fujiwhara, S.* On the abnormal propagation of sound waves in the atmosphere. *Abstracted in* MONTHLY WEATHER REVIEW, May, 1914, 42:258-265 [bibliography] and August, 1916, 44:436-439 [illust.].

PARHELIC CIRCLE WITH TWO PAIRS OF PARHELIA AT FARGO, N. DAK.

C. L. Meller, writing to the Scientific American (issue for Mar. 24, 1917, p. 305) from Fargo, N. Dak., reports the occurrence at that place on December 28, 1916, of a complete parhelic circle accompanied by the colored parhelia of 22°(?) and also by what appear to have been the faintly colored parhelia of 46°. The essential portions of his description follow:

> It was Thursday noon, the weather a few degrees above 0°F., * * * the thermometer began to drop * * *. At each side of the sun a sun dog stood, a condensed little rainbow with the red toward the sun, showing but little curvature and not a great many times longer than it was wide, with no great width at that. * * * A narrow band of light, readily visible, still not without a certain quality of faintness, * * * stretched from one sun dog to the other, not overhead but to the north, and no higher than the sun stood to the south. Twice the distance that each sun dog was from the sun this ring of light widened into an irregular disk of light that seemed each a second sun dog with the colors so faint that the eye could only discern them as a faint white light. * * * The sun dogs rose with the sun and stood with the sun until 3 o'clock in the afternoon, but the ring lasted only from about 11 till a little past noon.

It is unfortunate that the observer did not determine the angular positions of these parhelia on the parhelic circle; and it would also be interesting to know if the anthelion certainly did not form on this occasion.—C. A. jr.